INTERPRETATION IC 90.1-2010-21 OF
ANSI/ASHRAE/IES STANDARD 90.1-2010
Energy Standard for Buildings Except Low-Rise Residential Buildings

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Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE/IES Standard 90.1-2010, Section 6.5.2.2.1, relating to four-pipe common load systems.

Background: Four-Pipe Common Load Systems are briefly described in the article titled *Four-Pipe Common Load Systems* on page 13.20 of the 2012 *ASHRAE Handbook – HVAC Systems and Equipment*. This description cites leakage past the control valves (presumably the control valve that is inactive and consequently relied upon to shut off water flow from the inactive hydronic circuit) as the source of energy inefficiency (likely due to mixing heating water with cooling water at the leaking valve). It concludes with the statement that these systems are not allowed by ASHRAE/IES Standard 90.1 without going into detail.

Using a Four-Pipe Common Load System will require one coil in the fan powered air stream. Using a Four-Pipe Independent Load System will require two coils (one heating coil and one cooling coil) in the fan powered air stream, consequently increasing the fan power required per unit volume of air passing through the coil(s) over the Four-Pipe Common Load System. This increase in fan power is always present in constant volume systems and diminishes only in variable air volume systems during low air flow conditions. Removing the extra coil in a constant air volume zone reheat system allowed by Exception d. in Section 6.5.2.1 (and consequently reducing the system fan power) is possible (due to the similarity in water temperature rises and drops across the primary system air coils) and is highly desirable for the purpose of reducing total system fan power to meet the requirements of Section 6.5.3.1.1.

Interpretation: Section 6.5.2.2.1 Three-Pipe Systems prohibits the use of Four-Pipe Common Load Systems due to the leakage past the dormant control valves that are assumed to exist in these systems. If the leakage through the inactive piping circuit valves is successfully stopped, a Four-Pipe Common Load System will meet the requirements of ASHRAE/IES Standard 90.1.

Question: Is this interpretation correct?

Answer: Yes, Four-Pipe Common Load Systems are allowed but not for the reasons listed.

Comments: The statement in the 2012 *ASHRAE Handbook – HVAC Systems and Equipment* is not quite correct. On page 13.19, this Handbook states:

Many of these systems were installed and did not perform successfully because of problems in implementing the design concepts, and leakage through the control valves. These systems are not allowed for new application in energy standards such as ASHRAE 90.1, and are mentioned here as historical reference.

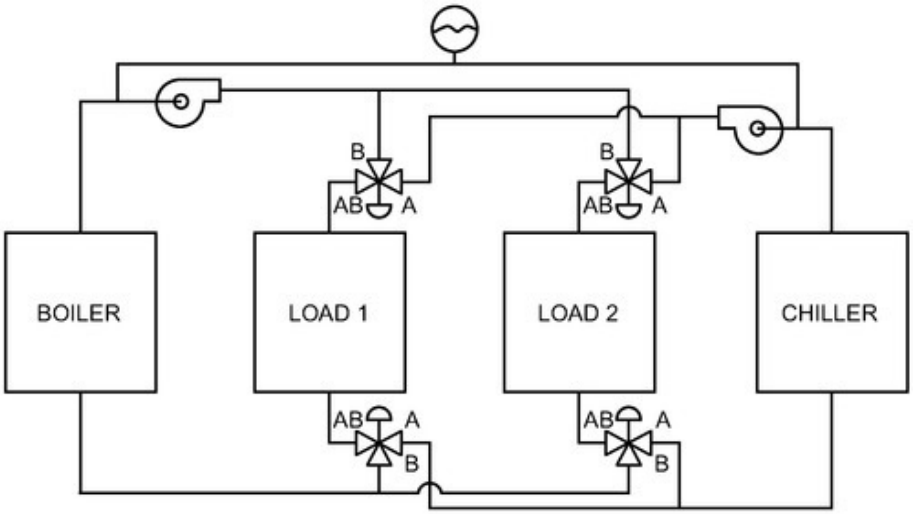
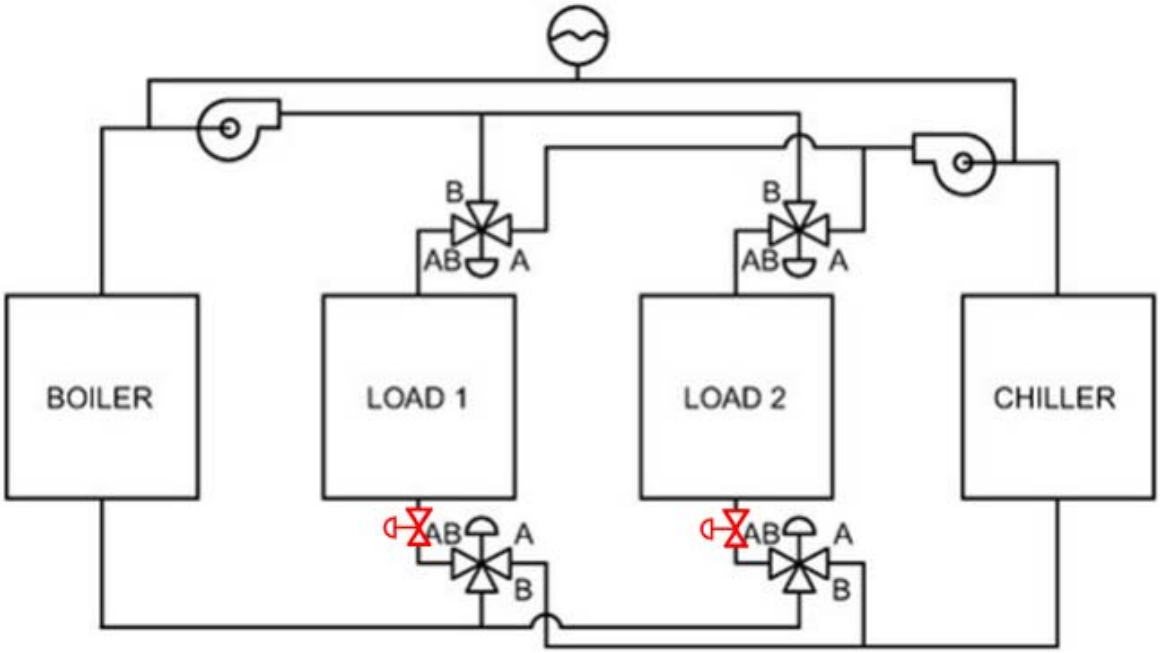


Figure 38. Four-Pipe Common Load System

The design shown above is problematic but not because of valve leakage. Valve leakage causes energy waste even if separate heating and cooling coils are used.

If one of the coil valves in the design above was a modulating valve, then mixing of HW and CHW would occur and the return pipe that connects to the coil would be a "common return", which is prohibited by Section 6.5.2.2 and 6.5.2.2.1. However, the design above would meet Section 6.5.2.2 if all the valves are two-position and controlled to simultaneously flip to connect the appropriate system, i.e. hot water supply to hot water return and chilled water supply to chilled water return. Nothing in Section 6.5.2.2 precludes this design since hot and chilled water are not substantively mixed. (The residual water in the coil will cause some energy waste but no more than if there were separate hot and chilled coils that were individually sequenced; in both cases, the water left in the coils must be reheated or recooled by the other system). However, with two-position valves, the system would then not meet 6.4.3.1.2 Dead Band requirements because the coil will always be heating or cooling and not able to provide a deadband where neither is provided.

If two-way control valves were added to the design as shown below in red and if the 3-way valves are two-position, the design would meet Standard 90.1. (Three-way valves could also be used where allowed by 6.5.4.2 Hydronic Variable Flow Systems.)



In summary, Section 6.5.2.2 does not preclude using one heat exchanger, such as a coil, a radiant panel, or a radiant slab, for both heating and cooling providing that the design does not cause deliberate mixing of water between the two systems.